

The sign rule, the 90 kHz math, and where the numbers live - on one page.

The two timestamps

PTS Presentation timestamp - WHEN TO SHOW the access unit (display).
DTS Decoding timestamp - WHEN TO DECODE the access unit (process).

Core rules

DTS <= PTS, always A frame is never shown before it is decoded.
Audio / no B-frames DTS = PTS. No reordering, so one timestamp is enough.
With B-frames DTS < PTS for reference frames - decoded early, shown later.
PTS is NOT wall-clock It is a count on the stream clock; zero point is arbitrary.

The 90 kHz math

Clock 90,000 ticks/s = 27 MHz / 300. PTS/DTS are 33-bit counts.
24 fps 90,000 / 24 = 3,750 ticks per frame
25 fps 90,000 / 25 = 3,600 ticks per frame
30 fps 90,000 / 30 = 3,000 ticks per frame
AAC @ 48 kHz 1,024 / 48,000 x 90,000 = 1,920 ticks per frame
Wraparound 2³³ / 90,000 ~ 26.5 hours, then rolls to 0

Where the numbers live

MPEG-2 TS / PS **PES header** PTS_DTS_flags (10=PTS, 11=PTS+DTS); 33-bit value in 5 bytes.
MP4 / ISOBMFF **sample-table boxes** stts durations -> DTS; ctts offset -> PTS; elst = edit list.

Remember

- Two timestamps per access unit: PTS (show) and DTS (decode).
- DTS differs from PTS only because B-frames force out-of-order decoding.
- MPEG-2: fixed 33-bit 90 kHz clock, value read straight from the PES header.
- MP4: timing is tables - stts gives DTS, ctts gives the PTS offset.
- MP4 timescale is per-track - convert ticks to seconds before comparing.
- Dropped ctts or elst on remux = classic recorded-media sync bug.
- PTS is not the time of day; map it via PCR (broadcast) or RTCP (WebRTC).
- The 33-bit clock wraps every ~26.5 h - handle the rollover in long streams.